surface of the earth generally consist of a rapid alternation of descending currents moving under the influence of upper isobars and ascending currents moving under the influence of sea-level isobars. At night time this vertical interchange is less important, and may even cease altogether. The result is a diurnal and reciprocal periodicity in the strength of the sea-level wind and of the currents at the lower cloud level, the latter being stronger in proportion as the former is weaker, as has been explained by Espy and Koeppen. There must also be a diurnal periodicity in the relation of the upper and lower isobars to the direction of the upper and lower currents, respectively. The currents at the level of cumulus clouds should be inclined to the upper isobars at a greater angle at the time of most active vertical interchange, say 2 p. m., and at a less angle at the time of minimum sea-level temperatures, say 6 a. m., but the Editor is not aware that observations are at hand to test the truth of this deduction.

MOVEMENTS OF CENTERS OF HIGH AND LOW BAROMETER DURING 1895.

The location of an area of high or low pressure is, to a limited extent, affected by the method adopted in the reduction of the barometer to sea level. The following summary, therefore, holds good, especially in connection with the method adopted by the Weather Bureau for the past few years. The average daily and hourly movements of the centers of the areas are given by paths and by days in the individual tables of the successive MONTHLY WEATHER REVIEW, and the monthly sums are collected together in the following table for the purpose of taking the annual means by paths and by days.

Movements of areas of high and low barometer for 1895.

Month.	High areas.				Low areas.			
	By paths.		By days.		By paths.		By days.	
	No.	Movement.	No.	Movement.	No.	Movement.	No.	Movement.
		Miles.		*Miles.*		*Miles.*		*Miles.*
January	11	10,409	28.5	25,000	15	10,326	46.0	29,400
February	12	7,341	37.0	21,050	17	10,457	43.5	26,400
March	11	7,041	41.5	24,150	18	12,756	46.5	32,200
April	10	5,814	65.0	88,890	14	8,971	66.5	40,500
May	6	8,142	19.0	10,200	8	4,185	29.5	15,450
June	4	2,393	24.5	14,558	4	1,862	17.5	7,880
July	11	5,168	36.0	16,670	11	5,711	42.5	21,890
August	14	6,823	42.0	20,480	17	9,077	62.0	28,920
September	9	4,688	43.0	21,520	9	5,276	36.0	20,920
October	11	6,765	46.0	29,510	15	9,364	50.5	30,850
November	4	2,087	37.5	18,960	10	8,199	21.5	17,470
December	3	1,457	12.0	5,915	14	10,525	46.5	32,980
Sums	106	62,073	434.0	241,398	152	96,709	509.5	304,800
Mean daily velocity	585		556		636		598	
Mean hourly velocity	24.4		23.2		26.5		24.9	

TEMPERATURE.

The mean annual temperature is shown by the isotherms on Chart I. These temperatures relate to the surface of the ground. The individual figures are given in Table I of data for Weather Bureau stations. The lowest annual averages within the United States were: St. Vincent, 35.3; Moorhead, 38.5; Sault Ste. Marie, 38.6; Williston, 38.9; Duluth, 39.1; Havre and Bismarck, 39.8. The highest averages were: Key West, 75.9; Jupiter, 72.8; Yuma, 72.4; Tampa, 70.9.

The mean annual temperature was above the normal in New England and in the Missouri Valley, elsewhere it was below the normal; the regions of large deficits were the east and west Gulf States.

The maximum temperatures are shown both by the upper figures and full lines on Chart II; the minimum temperatures of the year are shown by the lower figures and the dotted lines on the same chart. The absolute range of temp-

erature during the year is easily obtained by comparing the full and dotted lines on this chart. In general, maximum temperatures exceeding 100°, occurred as follows: 102, Columbia, S. C., Omaha, and Independence; 103, San Antonio, Tex., Sioux City, and Huron; 104, Walla Walla; 106, Pierre; 108, Red Bluff; 110, Fresno; the absolute maximum for the whole country was 114 at Yuma.

Minimum temperatures of 35° or less occurred at Bismarck, —39; Williston, —40; St. Vincent, —41; the absolute minimum for the whole country was —41° at St. Vincent.

The region of large annual ranges of temperature were: Upper Lake, Upper Mississippi and Missouri Valleys, the Dakotas, northern and middle Slopes.

The small annual ranges were: Key West, 42; Point Reys Light, 49.

The accumulated departures of average monthly temperatures are given in Table III, and show that there was a steady increasing deficit throughout the year over the lower Lakes, Atlantic and Gulf States, as also over the northern, middle, and southern Rocky Mountain Slopes, and the northern, middle and southern Pacific Slopes. A diminishing deficit amounting to an excess in some places prevailed in the upper Lake Region, North Dakota, the Mississippi and Missouri Valleys.

PRECIPITATION.

The total annual fall of rain and melted snow for 1895 is shown on Chart III. The greatest precipitation was Tatoosh Island, 92.95; East Clallam, 90.35; Jupiter, 70.47; Astoria, 70.75; the least was 1.33 at Yuma, 4.17 at Independence, and 6.84 at Winnemucca.

An annual rainfall above 60 inches occurred at Hatteras, Jupiter, East Clallum, Fort Canby, Pysht, Tatoosh Island, and Astoria.

An annual rainfall of less than 20 inches prevailed in North Dakota, the northern part of the Missouri Valley, and generally over the northern and middle Slope, the Southern, middle, and northern Plateau, and the south Pacific Coast regions.

The accumulated departures of total monthly precipitation from the normal values are shown in Table IV, from which it appears that a steadily increasing deffcit has prevailed in all regions except Florida, the southern Slope, and southern Plateau. The larger accumulated deficits were: Ohio Valley and Tennessee, 11.00; middle Atlantic, 9.10; upper Mississippi, 7.80; east Gulf, 8.60.

WIND.

The prevailing direction of the wind, namely, that which occurred most frequently at the two hours of regular observations for telegraphic report, 8 a. m. and 8 p. m., eastern time, is given in Table I. The annual resultant wind deduced from these same observations without taking account of the force of the wind (which is equivalent to attributing a uniform force to all winds) is given in table V. These resultants are also presented graphically on Chart I in connection with the barometric means. They should also be compared with the pressures on Charts IV and V to which they are intimately related.

Owing to the great labor of computation the resultant winds, as deduced from hourly readings of the self-registering anemometers, have not been computed during the year 1895, but the relation between the resultants from two observations per day and those from twenty-four hourly observations can be estimated by a comparison between Tables V and VI, pp. 544 and 545 of the Summary for 1894.

MOISTURE.

The mean temperature of the dew-point and the mean relative humidity are given in Table I.

For the sake of certain studies in hygiene the mean temperature of the wet-bulb thermometer has been given each month. The thermometer from which this temperature is read is whirled at the rate of about 10 feet per second within the light wooden shelter that protects from direct radiation. The average wet bulb for the year can be easily inferred from the mean temperature and dew-point of Table I as the wet-bulb reading is approximately midway between these two.

The total quantity of moisture in the air for the current year can be found by the table given on pages 539–540 of the Annual Summary for 1894, and does not differ to any important extent from the figures there given for that year.

FREQUENCY OF THUNDERSTORMS.

The successive MONTHLY WEATHER REVIEWS have given for each day and each State the number of thunderstorms reported by both regular and voluntary observers. Tables VI and VII give a summary of these monthly tables. In order to ascertain the relative frequency of thunderstorms, as explained in the Summary for 1884, it is proper to divide the number of storms reported by the number of stations in order to deduce the average number per station. The results of this division are given in the eighth column of the following table, which shows that the greatest frequencies per station per year are: Florida, 36.5; Louisiana, 20.7; Minnesota, 18.1; Missouri, 17.4. The smallest frequencies are: Oregon, 2.5; Washington, 2.2. The product of the observed number of thunderstorms by the reduction factors given in column five of the following table would give the approximate total number of thunderstorms for the respective States, which total number, of course, depends largely on the area of the State, and is omitted from this table, as it has no meteorological significance as compared with the frequency per station.

FREQUENCY OF AURORAS.

Tables VIII and IX give a summary of the detailed tables of auroral frequency in the respective MONTHLY WEATHER REVIEWS. In the absence of more precise knowledge, it is assumed that the number of observers reporting all auroras is the same as those reporting all thunderstorms; the total number of either class of observers is decidedly less than the total number of those who report rainfall and temperature. The total number of auroras reported divided by the number of observing stations for any State gives the relative frequency per station, and this number relates to a physical phenomenon and is comparable with similar ratios for other parts of the world, provided the aurora is so low as not to be obscured by a cloudy sky. On the other hand, if the auroral light emanate from a region far above the cloud, then a further correction

for cloudiness is needed, but this has not been applied in the present case, as the Editor believes that we have no certain proof as to the extreme altitude of the auroras, and that, on the other hand, there are many reasons to believe that it emanates from the cloud region itself and stands in intimate connection with the condensation of moisture by passing through a critical condition of molecular instability that apparently attends the formation of rain and snow.

Frequency of thunderstorms and auroras during 1895.

State.	Areas in units of 10,000 sq. miles.	Number of stations.		Reduction factor.	Total for 1895.		Frequency per station.	
		Needed.	Reporting.		Thunderstorms.	Auroras.	Thunderstorms.	Auroras.
Alabama	5.1	128	45	2.8	382	0	8.5	0.00
Arizona	11.4	385	30	12.8	190	0	6.3	0.00
Arkansas	5.2	130	40	3.2	393	0	9.8	0.00
California	15.8	395	115	3.4	157	3	1.4	0.08
Colorado	10.4	260	75	3.4	765	37	10.2	0.49
Connecticut	0.5	12	20	0.6	286	29	14.3	1.45
Delaware	0.2	5	6	0.3	85	26	14.2	4.36
District of Columbia	0.01	0.2	2	0.5	32	0	16.0	0.00
Florida	5.9	148	30	4.9	1,094	0	36.5	0.00
Georgia	5.8	145	45	3.2	371	0	8.2	0.00
Idaho	8.6	215	26	8.3	168	37	6.5	1.42
Illinois	5.5	138	75	1.8	955	90	12.7	1.20
Indiana	3.4	85	35	2.4	339	20	9.7	0.57
Indian Territory	6.9	172	5	34.4	42	0	8.4	0.00
Iowa	5.5	138	80	1.7	861	128	1.8	1.60
Kansas	8.1	202	65	3.1	519	32	8.0	0.49
Kentucky	3.8	95	35	2.7	212	4	6.1	0.11
Louisiana	4.1	102	45	2.3	983	0	20.7	0.00
Maine	3.5	88	15	5.9	134	111	8.8	7.40
Maryland	1.1	28	30	0.9	434	18	14.4	0.60
Massachusetts	0.8	20	65	0.3	640	127	9.7	1.95
Michigan	5.6	140	60	2.3	405	106	6.8	1.77
Minnesota	8.4	210	60	3.5	1,066	372	18.1	6.20
Mississippi	4.7	118	40	3.0	578	0	14.4	0.00
Missouri	6.5	162	80	2.0	1,391	17	17.4	0.21
Montana	14.4	360	25	1.4	132	111	5.3	4.44
Nebraska	7.6	190	80	2.4	557	79	7.0	0.99
Nevada	11.2	280	35	8.0	188	24	5.4	0.69
New Hampshire	0.9	22	20	1.1	174	187	8.7	6.85
New Jersey	0.8	20	45	0.4	595	46	13.2	1.02
New Mexico	12.1	302	25	12.1	148	0	5.9	0.00
New York	4.7	118	60	2.0	564	129	9.4	2.10
North Carolina	5.1	129	50	2.6	715	3	14.3	0.06
North Dakota	7.5	185	30	6.2	188	288	9.6	9.60
Ohio	4.0	100	125	0.8	1,360	126	10.9	1.01
Oklahoma			15		106	0	7.1	0.00
Oregon	9.5	238	45	5.3	111	2	2.5	0.04
Pennsylvania	4.6	115	70	1.6	752	27	10.7	0.39
Rhode Island	0.1	2	6	0.3	64	11	10.7	1.43
South Carolina	3.4	85	35	2.4	588	1	16.8	0.03
South Dakota	7.6	190	40	4.8	289	99	7.2	2.48
Tennessee	4.6	115	35	3.3	598	1	16.9	0.03
Texas	27.4	686	75	9.1	604	0	8.1	0.00
Utah	8.4	210	25	8.4	148	0	5.9	0.00
Vermont	1.0	25	12	2.1	151	60	12.6	5.00
Virginia	6.1	152	35	4.3	292	5	8.3	0.14
Washington	7.0	175	45	3.9	97	55	2.2	1.22
West Virginia	2.3	58	30	1.9	270	1	9.0	0.03
Wisconsin	5.3	132	55	2.2	720	277	5.0	5.04
Wyoming	9.8	245	10	24.5	84	8	3.4	0.80

THE ANNUAL SNOWFALL.

By the EDITOR.

The successive MONTHLY WEATHER REVIEWS give tables and charts showing the total snowfall during the month; the annual summaries may be made by presenting these monthly sums, either by calendar years, or by totals for the respective winters. Each method has its advantage in connection with some special study, but, both from an agricultural point of view and from the point of view of the geologist who is studying the phenomena of the Glacial epochs and that of the student of river flow, it is especially desirable to study the snowfall of the entire winter as a whole, avoiding the break at the 1st of January that is introduced by the tabulation according to calendar years. The Editor has therefore prepared from data furnished by Mr. A. J. Henry for the United States, and by Prof. R. F. Stupart for the Dominion of

Canada the accompanying tables, X and XI, respectively. These tables show the total snowfall received during the twelve months beginning July 1 and ending June 30 of the following calendar year. The tables begin with the year 1884, when the observers of the United States were generally requested to measure and record snowfall in a uniform manner, but many individual records could be compiled for earlier years. It may be possible, by charting the individual snowfalls, to insert approximate interpolated values for occasional missing years, and thus obtain a set of normals that shall be uniformly intercomparable, but this desirable step is deferred until the end of the lustrum 1896–1900, as adopted by the International Meteorological Congress.

The depth of snowfall is given as measured in inches when